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REVISION OF THE HOME DISTRIBUTION OF WOLFFIA ARRHIZA (L.)

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Abstract

Our smallest floriferous plant, *Wolffia arrhiza* (L.) HORKEL ex WIMMER 1857, is wide-spread in all flat areas of Europe, till the latitude of 15 north, resp. till the July isothermic line of 18 °C (in North-western Europe: 17 °C) where there is enogh eutrophic standing water, rich in nutritive matters. In countries lying in the north, full of mountains or having a dry climate, it is very rare or is entirely missing.

In our country, its distribution is fairly scattered although it is imaginable that, after a close scrutiny, we may obtain knowledge of much more habitats. It was known earlier only from the middle and south-eastern parts of the territory east of the river Tisza when, in 1972, I found it closed to the community Túrricse in county Szatmár. In the following years, I found more and more localities of it in that region and it proved to live in many places in the flatland of Szatmár-Bereg and even its newer occurrences in large numbers are to be expected.

In this region, it occurs mostly among *Spirodela polyrrhiza, Lemna minor, Salvinia natans, Utricularia vulgaris,* sporadically *Lemna trisulca,* etc. in various, convenient associations. Its ratios related to the enumerated species give in the surveys, on the average, 60 to 80 per cent values (Its characteristics are: A–D=between 3–5, resp. 4–5 (5–5); K= (in every case) V./. It is not rare in pure stands.

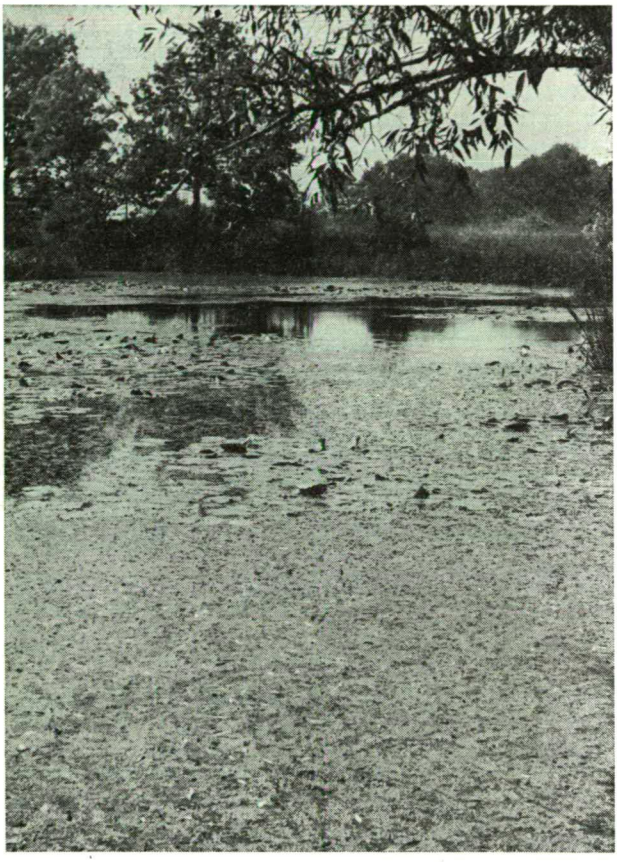
Our knowledge of its ecology, dispersion is sketchy and we are sure of that further investigation of these questions will furnish several more pieces of information.

Its suggested protection also means the necessity of protecting the water habitats. This is equally justified by its being scientifically and economically considerable.

*Wolffia arrhiza (*L. *1771) (=Lemna)* WIMMER *1857,* resp. with righ auctorial name W. *a.* (L.) HORKEL *ex* VIMMER *1857*" (KANDELER 1976) is the smallest floriferous plant. There have so far been few authors all over Europe who dealt with its research, outlining its area exactly. In more neighbouring countries, and even in this country, the investigation into water-plant associations came into prominence only since the latter years. In the course of works like these, about this — in many respects (both in scientific and economic questions equally) considerable but mostly easily lost-plant the collection of a more and more considerable body of knowledge is to be expected. Light is thrown on several biotopes of this plant, not known until now, just recently. In this country, too, it lives in more places than it is known so far in the literature on the subject. And owing to the insufficient attention paid to it, it is not impossible that it was much more frequently occurring before the beginning of the flood defence and reclaiming works. Today we can only try to guess whether its multiplying recent data are really its new appearances or only the present detections of its since very long

hiding occurences. It is imaginable, too, that we only see the ecological changes taking place in extensive areas, spreading of minor stands which survived in some suitable, concealed, remotest corners of the country.

Wolffia is an ecologically indifferent, thermophilous plant. Floating in eutrophic standing waters, rich in nutritive matters, it occurs in large numbers. It is a *Lemnion* character-species, forming associations, respectively it presents itself in the following



Photograph 1. Mill-pond at Csaholc (Photo by I. FINTHA).

plant associations: *Wolffietum arrhizae, Wolffio-Lemnetum gibbae,* and additionally in *Salvinio-Spirodeletum (-polyrrhizae Wolffietosum), Stratiotetum (Hydrochari-Stratiotetum), Ceratophylletum demersi, Ceratophylletum submersi, Lemno-Utricularietum, Myriophyllo-Potametum, Parvopotameto-Zanichellietum,* as well as in reeds *(Scirpo-Phragmitetum, Acoretum)* and, farther from our country, in others, as well (Soó 1973).

It is floristico-phytogeographically a flatland kollin, wide-spread in the eastern hemisphere, in Europe it is an Atlantic-Mediterranean floristic element (Soó 1973) or, according to others, a subtropical one (Asia, Africa, Australia), in Northern Europe it is adventive (BEĆAREVIĆ 1953), resp. cosmopolitan (SOÓ–JÁVORKA 1951). In this country, it is perhaps neophytic (Soó 1973). It spreads by means of water,

wind, water-birds. The migrating water-fowl can carry it on its leg, bill, feathering far away on the pathway of its migration. In this country, it is not propagated by zoogamy. And even, there is only known a single flowering datum of it, from the northern foreground of the Caucasus (BENKOVÁ 1957).

6–8 of the 14–16 species of the genus are only American, 1 species is Central-American, 5 species are only African, 1 species is from Central Asia and 1 species is Eurasian–African–Australian (KANDELER 1976). The latter one *W. arrhiza,* has spread in Europe till the latitude of 55° north. More exactly it lives till the isothermic line where the July mean temperature is 18 °C (resp. in North-Western Europe, as well as in the south-eastern part of the British Isles 17 °C), in 0.75–1.5 m deep waters (KANDELER 1976) (Cf. with the map, too).

It is in Europe mainly the inhabitant of the southern and western flat areas. In the south and on the higher reliefs, in the mountains — owing to its thermophilic nature — it is missing and it can, of course, not be found in the dry provinces, either.

On the territory of Hungary, the water-meal is of fairly sporadic distribution although — because of the incidental form of its research — its exact data are not known. The literature on its home occurrences is small and in some cases it is difficult to be brought to light. In the following, I arrange these in time order and speak among them of the observations not published as yet. At last, I also publish the results of my own investigations.

From among our divers, L. SIMONKAI met it first, detecting it in or about 1880 in Pancsova, in a reservoir (DEGEN 1910). About thirty years thereafter, A. DEGEN found it in the Lake Grobnik in the neighbourhood of Fiume, in his collecting way on 8 August 1910 (DEGEN 1912). For the third time, it was found by E. Unger in the water of the Mosztonga in County Bács–Bodrog, in September 1915 (UNGER 1916).

On the present-day territory of our country, it was described first by Á. BOROS from the Danube-Arm at Soroksár, in 1946. At the same place it had been looked for in vain for years but then it appeared again. L. ALMÁDI observed its occurrence close to Szarvas, in the water of a Körös Dead-Arm in 1958 (VÖRÖSS 1966). This latter is, at the same time, its first datum from beyond the Tisza. Its occurrences here and in the brooklet Korhány in Rumania (POP 1968) are obviously in connection with each other.

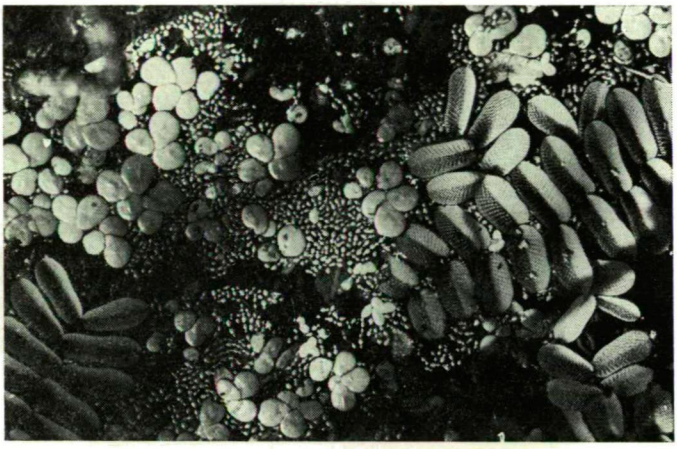
In the Autumn of 1960, and in 1961, it appeared in an immense quantity in the Tisza Dead-Arm, on the confines of the community Oszlár. It has been, as the author writes, to be found since then — with the exception of the full draining of the ox-bow lake in 1962 (TÓTH 1972). In Lake Velence, it was seen by L. TÓTH on the water of a clearing in a reedy marsh, in 1960 (VÖRÖSS 1966).

A newer habitat on the territory east of the Tisza was also been found by S. TÓTH at Tiszaluc, where a stand of lower density lived. (TÓTH 1972).

Among its home occurrences the most important ones are those in Szatmár Bereg. I have first found it in this most eastern region of our country and one of the most northern parts of the Great Hungarian Plain, in 1972, two years after the oversized Tisza–Szamos flood. I found it then in varying amount on the confines of the community Túrricse, in the dead bed of the former brook Túr meandering through the forest of Ricse, in *Lemno-Utricularietum* association. The biotope which is humid through the whole year is surrounded by a very nice hornbeem oak-plantation *(Querco robori-Carpinetum hungaricum)* the remarkable underwood of which is full of montanic species. (Apart from the known occurrences: *Polypodium vulgare, Heracleum Sphondylium, Asarum europaeum, Lathyrus niger, L. vernus, L. Nissolia, Circaea lutetiana, Impatiens noli-tangere, Gentiana pneumonanthe, Symphytum tuberosum,*

Ajuga reptans, Galeopsis speciosa, Lamium Galeobdolon, Paris quadrifolia, Melampyrum nemorosum, Lathraea squamaria, Scilla bifolia, Majanthemum bifolium,, Leucojum vernum, Gladiolus imbricatus, Luzula pilosa, Melica nutans, etc.). It is a fault that the conservation of the area is not solved, as yet.

In the following years, 1973 and 1974, I saw *Wolffia* in many places between Túrricse and Kölcse, but in the largest numbers, anyway, in 1974 in the area of Nagyrekesz, on the confines of Csaholc, full of ox-bow lakes, in the old-time Túr-stretch, made wider for the sake of a water-mill which operated here in olden times. The water surface was covered here and there by its pure stands. It occurred, however, generally in *Salvinio-Spirodeletum polyrrhizae* associations, spreading among the floating groups of *Spirodela polyrrhyza* and *Salvinia natans.*



Photograph 2. *Wolffia* stand in *Salvinio-Spirodeletum (polyrrhizae Wolffietosum).* Csaholc Millpond. (Photo: I. FINTHA)

I know from the oral information of my colleague, I. TÖLGYESI, botanical superviser of the Kiskunság National Park, that he also found water-meal in the area of the communities Lakitelek and Alpár, in the hair-weed vegetation of the ox-bow lakes Kis-Sulymos and Nagy-Sulymos, as well as in the moorish waters of the high sedge associations in the Tőserdő. Its occurrence here can be brought into connection — taking into consideration the possibility of its spreading with water — with its appearance in the flatlands of Oszlár, Tiszaluc and possibly Szatmár. It is also not excluded that it has been living in all these mentioned areas from ancient time.

Likewise in 1976, my colleague A. LEGÁNY, nature conservancy superviser, found it at Tiszadob, in the ox-bow lake ot the river Tisza at Szelep. It was present there then in changing quantity, among *Stratiotes aloides, Hydrocharis morsus-ranae,* as well as *Spirodela polyrrhyza.* In the photograph attesting its presence, apart rrom it, *Spirodela* takes part and the total covering of both species is about 60 to 65 percent. Water-meal is hardly 8 to 10 percent of the amount of Spirodela. This datum is also to be connected with those mentioned above.

It was looked for and found, upon my request, also by I. D. PETHE, teacher in Beregsurány, in more than one place in the water of the marshy brook flowing through the Déda-forest past Beregdaróc and in the Tisza Dead-Arm named Badaló-szeg past

Tarpa, in June 1977. The Déda-forest similarly abounds in plant species of alpestrine distribution *(Galanthus nivalis, Scilla bifolia, Leucojum vernum, Isopyrum thalictroides, Anemone nemorosa,* etc. And the beech occurs — apart from Long-forest lying between Sárospatak and Sátoraljaújhely — alone here in the Great Hungarian Plain). In the forests of Tarpa *Crocus heuffelianus* and *Fritillaria meleagris* live and *Lacerta vivipara* is also wide-spread there!

After these, I found myself *Wolffia* in July 1977, in the Dead-Szamos, meandering in the confines of the community Fülpösdaróc where it occurred in the largest numbers among its biotopes observed so far in the flatland at Szatmár. At the river-sides, the fragments or degraded spots of *Salicetum albae-fragilis* stood, here and there mixed with alder, mulberry *(Alnus glutinosa; Morus alba, M. nigra),* and mostly acacia *(Robinia pseudacacia).* Below, the fringe was given by the multicoloured mosaic of associations bordering the water *(Phragmition, Potametum natantis, Chenopodietum rubri, Nanocyperion flavescentis, Eleocharitetum ovatae, Eleochari aciculari-Schoenoplectetum supini, Cypero-Juncetum, Echinochloo-Setarietum, Bidentetum tripartiti, B. t. xanthietosum, Rudbeckio-Solidaginetum,* etc.). In the water environment, there were mostly reed and bulrush *(Phragmites communis, Typha angustifolia, T. latifolia),* in separated stands and mixed, as well. There were to be seen a few *Schoenoplectus lacustris,* in clusters at the edge of water, resp. reeds, as well as *Butomus umbellatus.* At the river-side and along the reeds, there were often to be seen sporadically *Alisma plantago-aqautica* and *Lysimachia vulgaris,* and here and there *Oenanthe aquatica* in large numbers. Large carpets of floating hair-weeds were made by *Trapa natans,* smaller ones by *Hydrocharis morsus-ranae. Salvinia natans* could be seen here and there or rather it was missing from large areas. *Potamogeton natans* was floating in small numbers sporadically at the surface of water. Members of the submersible hair-weed were *Potamogeton crispus, P. gramineus,* and *Myriophyllum spicatum.*

Water-meal was to be found in several places, everywhere in a very dense stand. I have found here two large, more or less continuous habitats of it. Both of them took place 250–300 m long and in a 15–35 m broad zone. *Wolffia* also protruded into surrounding the stocks of reed and bulrush closely. It has covered, in the below described percentage, the water surfaces of the zone between the outer fringe of reeds and the line of the river-side in a space of changing breadth, in places sheltered from the wind and free from rolling water, in a water of 0.01–1.20 m depth. (It is to be remarked here that the 0.75–1.50 m water depth, mentioned in the Austrian literature, is not at all a determined interval in respect of the limits of the occurrence of *Wolffia.* I know from experience that in case of this floating species of tiny stature the depth of water is — if otherwise all the essential conditions for living are given — considerable only in so far as the rolling water resp. the sweeping effect of the wind does or does not prevail in the habitat. The dispelling work of wind makes alone impossible its occurrence in groups at the surface of the deeper water ranges. If the strength of the wind is bound by reeds or another dense vegetation of strong fibres then water-meal can multiply even at the surface of a 2 m deep water).

The relative quantitative relations, observed in one of the habitats (in 10×10 cm squares, at 100 percent total covering) were on July 1977 as follows:

Woffia arrhiza	60–90 p.c. (A–D: 4–5; K: V)
Spirodela polyrrhiza	10–25 p.c. (A–D: I–2; K: IV)
Lemna minor	8–10 p.c. (A–D: 1; K: V)

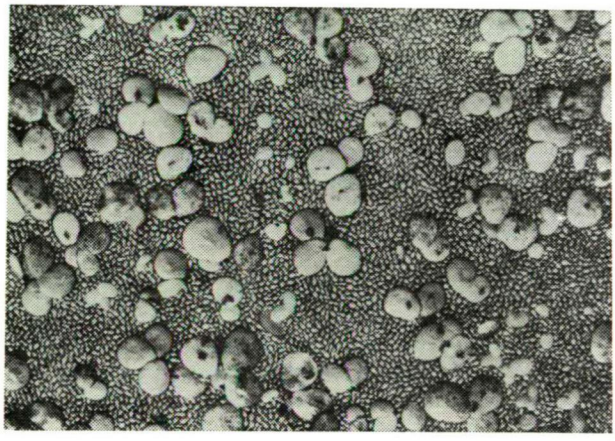
In the other habitat similar conditions were found but here, very sporadically, *Salvinia natans* also appeared (0–3 p.c.; A–D: 0 – +; K: I).

On 14 September 1977 the following relative quantitative relations were found in the Mill-pond at Csaholc (25×25 cm squares, at all surveys 100 percent total cover), in one or the other half of the ox-bow lake divided by the causeway built in this year:

I. *Wolffia arrhiza*	20–40 p.c. (A–D: 2–3; K:V)
Spirodela polyrrhiza	20–60 p.c. (A–D: 2–3; K:V)
Salvinia natans	10–55 p.c. (A–D: 1–3; K:V)

The stand is here and there interrupted by smaller or larger groups of Sparganium erectum, Sagittaria sagittifolia, and Nuphar luteum.

II. *Wolffia arrhiza*	70–90 p.c. (A–D: 4–5; K:V)
Spirodela polyrrhiza	10–20 p.c. (A–D: 1–2; K:V)
Salvinia natans	0–10 p.c. (A–D: 0–1; K:II)



Photograph 3. *Wolffia* stand in *Scirpo-Phragmitetum*. Fülpösdaróc. (Photo: I. FINTHA).

Here, along a many hundred metres stretch, this is the characteristic state. The appearance of the gutterless causeway, sundering the dead-arm, is a very regrettable event because it immediately severed the natural connections of the surrounding waters. Among our protective measures, it is unavoidably important to treat this question at length, as soon as possible.

At the same time, I have found newer habitats of wate-meal between Csaholc and Túrricse, in the longer, resp. horseshoe-shaped shorter ox-bow lakes, meandering in the neighbourhood of the left water-side of the dug Túr. Its recorded data, in

10×10 cm squares in the second dead-arm lying towards Ricse from the Borzsa-bridge, (at 100 percent total covering, on 14 September 1977) are the following:

Wolffia arrhiza	55–80 p.c. (A–D: 3–5; K:V)
Spirodela polyrrhiza	5–20 p.c. (A–D: 1–2; K:V)
Lemna minor	10–30 p.c. (A–D: 1–2; K:V)

In the next dead-arm towards Ricse, about 150 m long and 8–10 m broad an almost 100 percent pure cover is present (14 September 1977):

Wolffia arrhiza	95–100 p.c. (A–D: 5–5; K:V)
Lemna minor	0–5 p.c. (A–D: 0–1; K:I)

I have investigated, in the same period, into further waters but in those, enumerated below, I looked in vain for *Wolffia:* the waters of Déda-forest — Szipa-canal at Beregdaróc (only *Lemnetum;*) Gőgő's water at Nagyszekeres (only *Lemna* and *Spirodela);* water of the Szenke at Penyige (only *Lemna* and *Spirodela*): a longer stretch of the Túr in the confines of Túristvándi (only *Lemnetum*): bed of the Noborda in the Borzova-forest and the near-by canals on the confines of Nemesborzova (only *Lemnetum)*: Szamos dead-arms at Géberje, in the vicinity of Győrtelek and Tunyogmatolcs; the old ox-bow lake surrounding the church of Csengersima and the Vájás at Győrtelek-Kocsord. It is strange that I have also found entirely empty the horseshoe-shaped ox-bow lake in the area of the Ricse-forest which did not contain any water plant in spite of that I had found here water-meal first in the flatland of Szatmár-Bereg (1972).

In 1978, I did not find any newer habitat of water-meal, either. In the dead-arm at Fülpösdaróc its stand was poorer (July 6), on the other hand, I have observed here the appearance of *Lemna trisulca* in several spots.

I have not seen it either in the region of the Hortobágy or in the ox-bow lakes following the Tisza reaches between Ároktő and Tiszafüred although the ecological-coenological conditions would be satisfactory to it in most places.

Apart from publishing the most important information about the habitats, occurrences not cleared up so far of our plant, I have as a first task only summarized everything we can at present know about the state of water-meal in Hungary, completing it with the known few literary data. All this is, however, not much, and it can only inspire us to collect — using the existing bases — more and more material of this neglected species and — together with this — of the water associations, growing spaces which are in several respects (thus from economic point of view, as well) very considerable. It is, at any rate, necessary to continue its research because, apart from that the relations of its distribution are not cleared up, as yet, we are in want of knowledge of many parts of its ecology, as well.

The protection of Wolffia is suggested by KOVÁCS–PRISZTER (1977) but it is to be added that this can only be imagined by protecting the whole habitat. This would serve, at the same time, the conservation of several valuable, accasionally also rare, perishing plant and animal species, which is, at present to be accentuated more and more at any rate.

Last but not least, I should lik to express my profound appreciation to the folowing colleagues for helping me in bringing about this work by participating in observations and research: BENCZE, L. (Csaholc); KÓNYA, J. (Zsarolyán); LEGÁNY, A. (Tiszavasvári); D. PETHE, I. (Beregsurány); TÖLGYESI, I. (Kiskunság National Park, Kecskemét).

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A Wolffia arrhiza L. hazai elterjedésének revíziója

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Kivonat

Legkisebb virágos növényünk, a *Wolffia arrhiza (L.)* HORKEL EX WIMMER 1857., Európában az északi szélesség 55°-áig, illetőleg a 18 °C-os (ÉNy-Európában 17 °C-os) júliusi izoterma vonaláig minden síkségi területen elterjedt, hol elegendő a tápanyagokban gazdag (eutróf) állóvíz. Északon fekvő, hegységekkel teli vagy száraz klímájú országokban igen ritka, sőt hiányzik.

Hazánkban meglehetősen szétszórt elterjedésű, bár a vele kapcsolatos kutatások alaposabbá válásával elképzelhető, hogy jóval több élőhelyéről szerzünk tudomást. Korábban a Tiszántúlnak csak középső és délkeleti részeiből volt ismert, mikor 1972-ben megtaláltam a Szatmár-megyei Túrricse község mellett. A következő években egyre több új lelőhelyére akadtam a környéken s bebizonyosodott, hogy a Szatmár-beregi síkságon igen sokfelé él, sőt újabb tömeges előfordulásai is várhatók.

E tájon leginkább *Spirodela polyrrhiza, Lemna minor, Salvinia natans, Utricularia vulgaris* helyenként *Lemna trisulca* etc. között fordul elő különböző, megfelelő asszociációkban. A felsorolt fajokhoz viszonyított arányai a felvételekben átlagosan 60—80%-os értéket adnak [karakterisztikái: A—D=3—5, ill., 4—5 (5—5) között; K=(minden esetben) V.]. Nem ritka tiszta állományokban.

Ökológiájáról, elterjedéséről hézagos ismeretekkel rendelkezünk s biztos, hogy e kérdések további vizsgálata még számos információval fog szolgálni.

Javasolt védelme a vízi élőhelyek oltalmának szükségességét is jelenti, mely azok tudományos s gazdasági jelentőségével egyaránt indokolt.

Revizija rasprostra Wolffia arrhiza L. u Madjarskoj

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Abstract

Naša najmanja cvetnica *Wolffia arrhiza* (L.) HORKEL EX WIMMER, 1857., u Evropi je do 55° severne širine, odnosno do 18 °C (u Severozapadnoj Evropi do 17 °C) julske izotermne linije na svim ravničarskim područjima rasprostranjena u eutrofnim stajaćim vodama. U planinskim predelima severnih područja ili zemalja sa suvom klimom je veoma retka ili odsustvuje.

U našoj zemlji je prilično rasprostranjena, iako je na osnovu intenzivnijih istraživanja za očekivati njeno prisustvo sa više biotopa. Do sada je bila poznata sa srednjih i jugoistočnih područja is točno od reke Tise. 1972. god. smo je registrovali pored naselja Turricse u županiji Szatmár. Narednih godina smo registrovali sve veći broj biotopa u okolini i pokazalo se da je na ravničarskom području Szatmár-bereg široko rasprostranjena, kao i da je moguće očekivati njenu noviju masovnu

Na ovom području uglavnom se pojavljuje sa *Spirodela polyrrhiza, Lemna minor, Salvinia natans, Utricularia vulgaris,* ponegde sa *Lemna trisulca* etc. sa različitim i odgovarajućim asocijacijama. U ispitivanim probama, u odnosu na navedene vrste u proseku se javlja sa 60—80% (sa karakjeristikama: A—D=3—5 odnosno izmedju 4—5 (5—5); K=(u svim slučajevima) V.). Nisu retke njene čiste sastojine.

O njenoj ekologiji i resprostranjenju raspolažemo sa sporadičnim podacima. ali je sigurno tde istraživanja u ovom pravcuenpojavu nove informacije. Njena predložena zaštita u isto vreme će u prilog i potrebi zaštite vodenih biotopa, koja je kako sa naučne, tako i sa ekonomske strane oprovdana,

Исследование распространённости Wolffia Arrhiza в Венгрии

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Резюме

Самое мелкое цветочное растение нашей страны *Woiffia arhiza* (L') HORKEL ex WIMMER 1857 распространено на всех равнинных территориях Европы вплоть до 55° северной широты, то есть в пределах июльской изотермы в 18 °C (в Северо-запЕвропе — 17 °C), где достаточно богатой питательными веществами стоячей воды. В северных гористых странах с сухим климатом это растение является крайне редким, часто вообще не растёт.

В нашей стране распространённость его отличается большой разбросанностью, хотя можно предполагать, что более основательные исследования в этом отношении откроют их новые местонахождения этого растения. До того, как мною это растение в 1972 году было обнаружено в области Сатмар, село Туричче, оно было известно в нашей стране лишь в средней и юго-восточной части Затисайской обл. В последующие годы я находил всю больше местонахождений его в обл. Сатмар. Оказалось, что на равнине Сатмар-Береги есть много разновидностей его, более того, ожидаются новые места его массового распространения.

На этих почвах в различных соответствующих ассоциациях он встречается в первую очередь спеги *Spirodella pollirrhiza, Lemna minor, Salvinia natans, Utricularia vulgaris,* иногда *Lemna tricula* Как показывают взятые пробы, содержание его в перечисленных разновидностях составляло 60—80 % (характеристика: A—D=3—5 или 4—5(5—5); K= (во всех случаях). Нередко встречается в чистом составе.

Относительно экологии и распространённость *Wolffia arrniza* мы располагаем пока лищьнебогатым запасом знаний. Бесспорно, что дальнейшие исследования обогатят новой обширной информацией.

Рекомендуемая защита этого растения распространяется и на его водные местонахождения, что обусловлено их научным и экономическим значением.